

CLAIMS

We claim:

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1. An electro active device for generating a directional beam comprising:  
first and second electro active substrates each having first and second opposed continuous planar surfaces wherein each of said first opposed surfaces have a polarity and each of said second opposed surfaces have an opposite polarity, wherein said first opposed surfaces of said first and second electro active substrates are in close contact;  
a first electrode coupled to a junction formed by said first opposed surfaces having the same polarity;  
a second electrode coupled to said second opposed surface of said first electro active substrate;  
a third electrode coupled to said second opposed surface of said second electro active substrate;  
a first endcap joined to said second opposed surface of said first electro active substrate; and  
a second endcap joined to said second opposed surface of said second electro active substrate;
2. The electro active device of claim 1, wherein said first and second electro active substrates are disc shaped.
3. The electro active device of claim 1, wherein said first opposed surfaces of said first and second electro active substrates are bonded by a conductive layer to form said junction.
4. The electro active device of claim 1, wherein said first and second electro active substrates are formed of an electrostrictive material

5. The electro active device of claim 1, wherein said first and second electro active substrates are formed of a piezoelectric material.

6. The electro active device of claim 5, wherein said first and second electro active substrates are poled in a direction perpendicular to their respective first and second opposed continuous planar surfaces.

7. The electro active device of claim 1, wherein said first endcap further comprises a truncated conical shape and a rim portion joined to said second opposed surface of said first electro active substrate.

8. The electro active device of claim 1, wherein said second endcap further comprises a truncated conical shape and a rim portion joined to said second opposed surface of said second electro active substrate;

9. The electro active device of claim 1, further comprising:

first circuitry for applying a first electric field across said first and second electrodes; and

second circuitry for applying a second electric field across said first and third electrodes, said second electrical field having a phase relationship with said first electrical field,

wherein the application of said first and second electrical fields causes said electro active device to produce a combined flexural and bending motion.

10. A method for generating a directional beam utilizing an electro active device comprising first and second electro active substrates each having first opposed planar surfaces of the same polarity in close contact, said first and second electro active substrates each having a second opposed planar surface joined to an endcap having a truncated conical shape, said method comprising:

applying a first electrical field to a said first electro active substrate;

applying a second electrical field to said second electro active substrate,

wherein said first and second electrical fields have an amplitude and phase relationship such that said electro active device produces a combined flexural and bending motion.

11. The method of claim 10, wherein said first and second electro active substrates are disc shaped.

12. The method of claim 10, wherein said first opposed surfaces of said first and second electro active substrates are bonded by a conductive material to form a junction.

13. The method of claim 10, wherein said first and second electro active substrates are formed of an electrostrictive material

14. The method of claim 10, wherein said first and second electro active substrates are formed of a piezoelectric material.

15. The method of claim 14, further comprising poling said first and second electro active substrates in a direction perpendicular to their respective first and second opposed planar surfaces.

16. The method of claim 10, wherein each endcap each further comprises a truncated conical shape and a rim portion joined to said second opposed surface of said first and second electro active substrates, respectively.

17. A vibration production system comprising:

a plurality of electro active devices for generating a directional beam of vibration arranged in an array, each electro active device having:

first and second electro active substrates each having first and second opposed continuous planar surfaces wherein each of said first opposed surfaces have a polarity and each of said second opposed surfaces have an opposite polarity, wherein said first opposed surfaces of said first and second electro active substrates are in close contact;

a first electrode coupled to a junction formed by said first opposed surfaces having the same polarity;

a second electrode coupled to said second opposed surface of said first electro active substrate;

a third electrode coupled to said second opposed surface of said second electro active substrate;

a first endcap joined to said second opposed surface of said first electro active substrate; and

a second endcap joined to said second opposed surface of said second electro active substrate;

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